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# Electronics and DAQ Update

## WBS 1.6, 2.6, 1.7, 2.7

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**March 11-12, 2006**



# Recent Work

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- Work going on at integration interfaces
  - Carrier Board – APD
    - Working toward integrated design
  - APD Module – PVC Module
  - Infrastructure – Installation
    - Defining Needs
  - Electronics – DAQ
    - Defining protocol



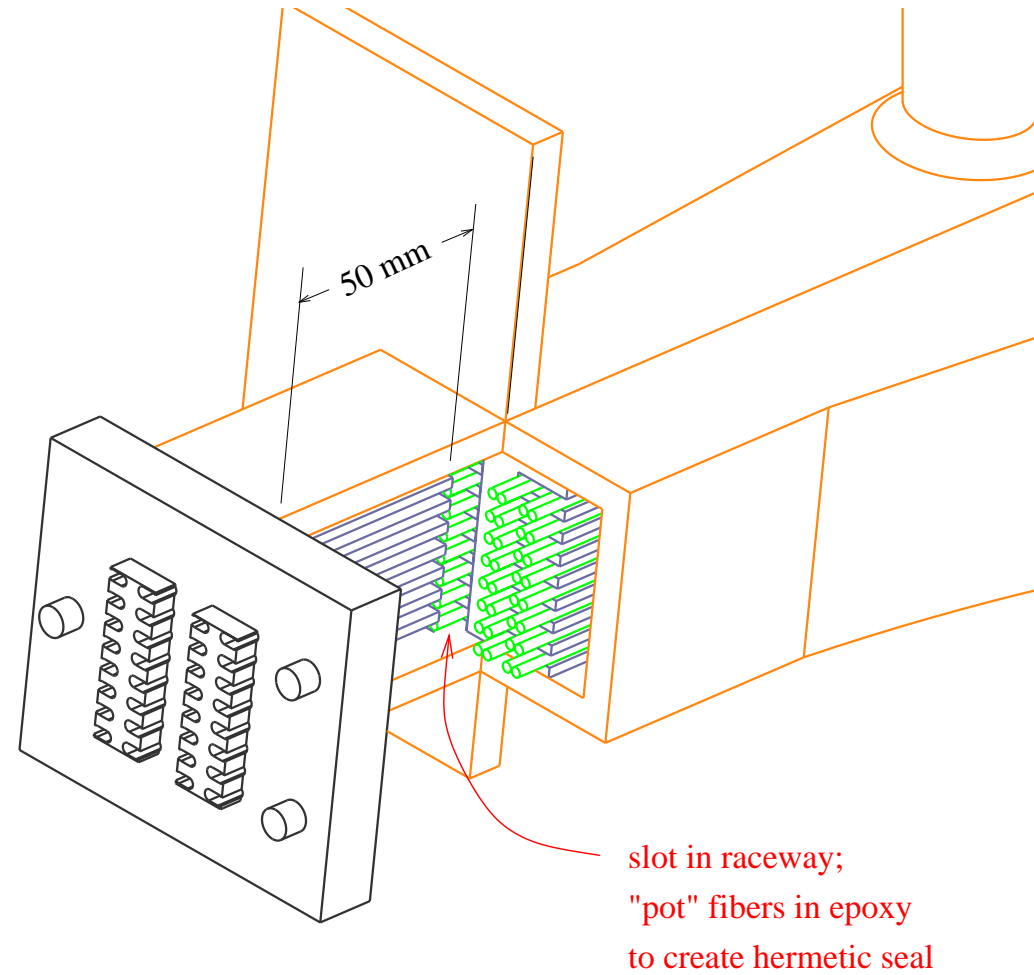
# DAQ Software Opportunities



- Event Monitoring System
  - System that monitors data during running periods for quality. Statistical sampling and analysis of data as it flows through the system to show trends in the data. Early Start of 01 August 2006.
- Event Display System
  - Reconstruction and graphical display of events. Diagnostic tool during commissioning and running as well as data analysis and preparation for presentations. Early Start of 01 August 2006.
- Calibration Database Application
  - Storing and retrieving calibration data. Needed for configuring detector electronics and later data analysis. Early Start is 16 May 2006.
- Run History Database Application
  - Storing and retrieving records about run conditions and operator comments. Management of records on detector run conditions during and after data taking. Early Start is 16 May 2006.

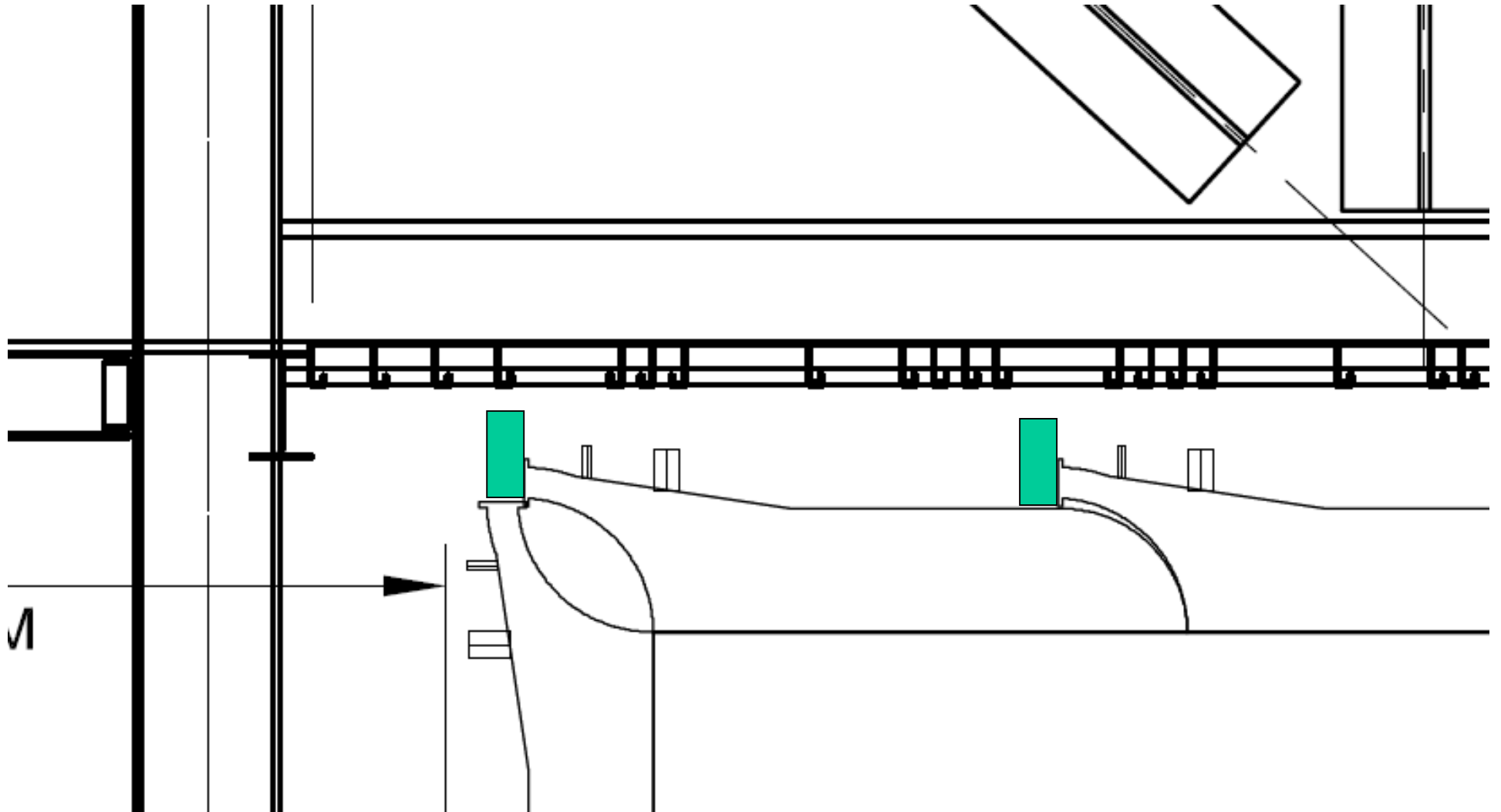


# Preventing Condensation at the Optical Connector



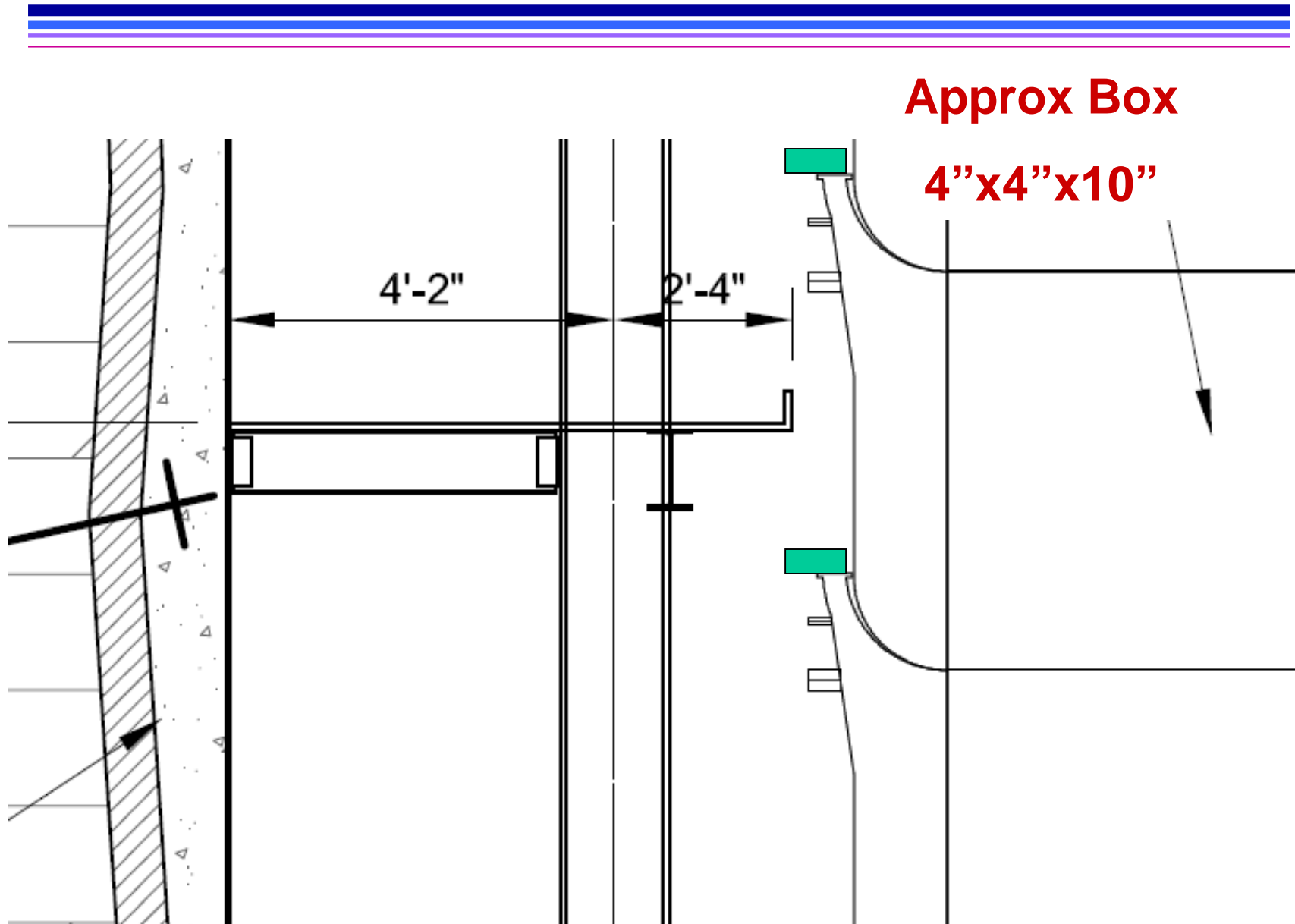


# Top Installation



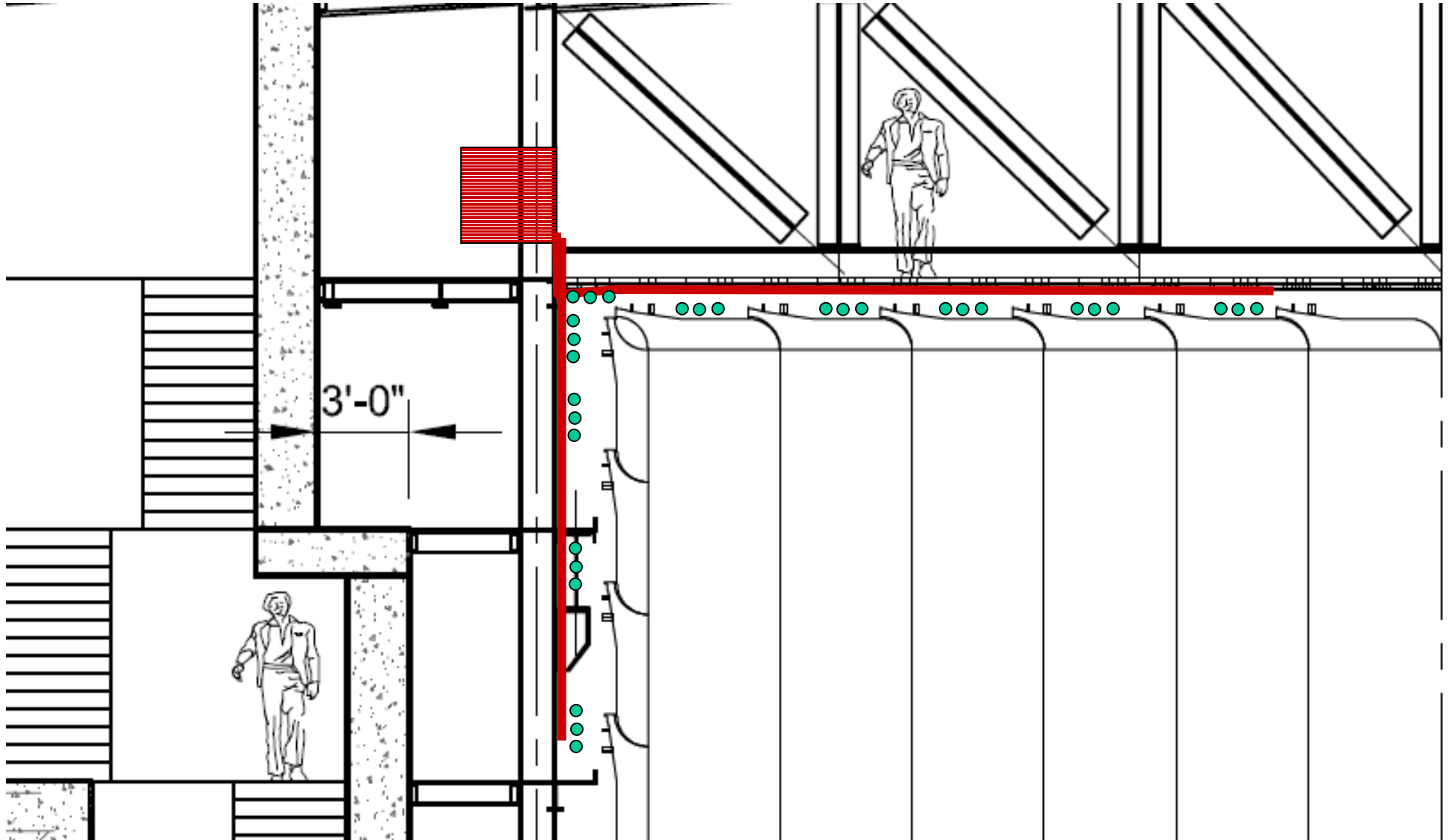


# APD Readout Box Installation





# Utilities Version A



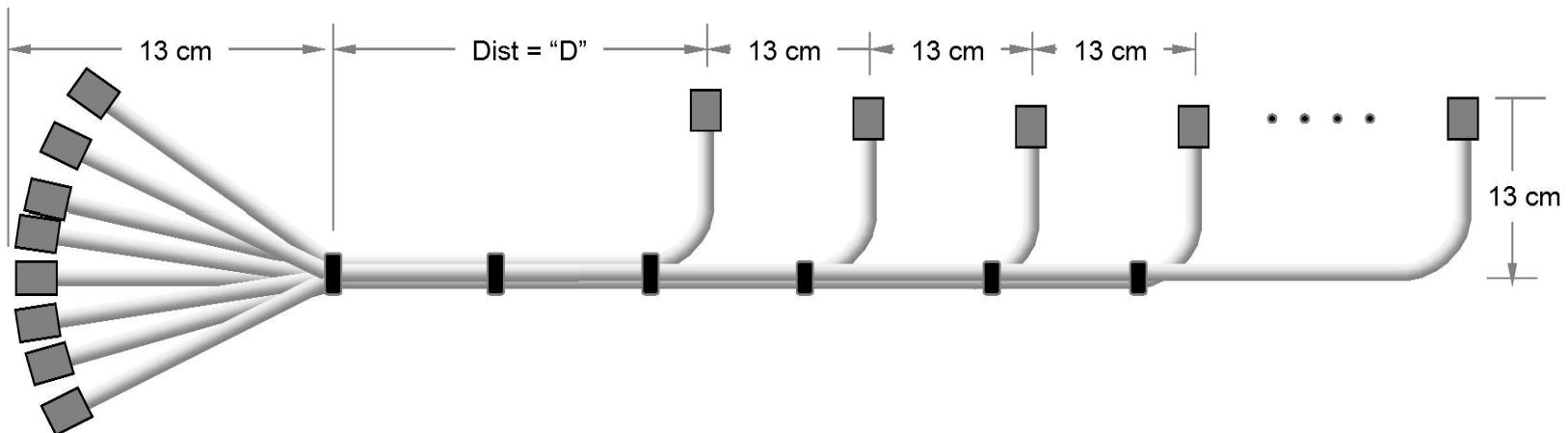


# Signal Cabling, Power Distribution



Cable type	Connector type	No per harness	Breakout pitch (cm)
Cat 5	RJ45	8	13

Type	Dist "D" (cm)	Qty – harness'
#1	75	3,200
#2	200	3,200



For budgetary quotation only  
Drawing not to scale





# Top Power/Data



High Voltage  
Low Voltage  
Local redistribution  
(1.7m avg. cable length)

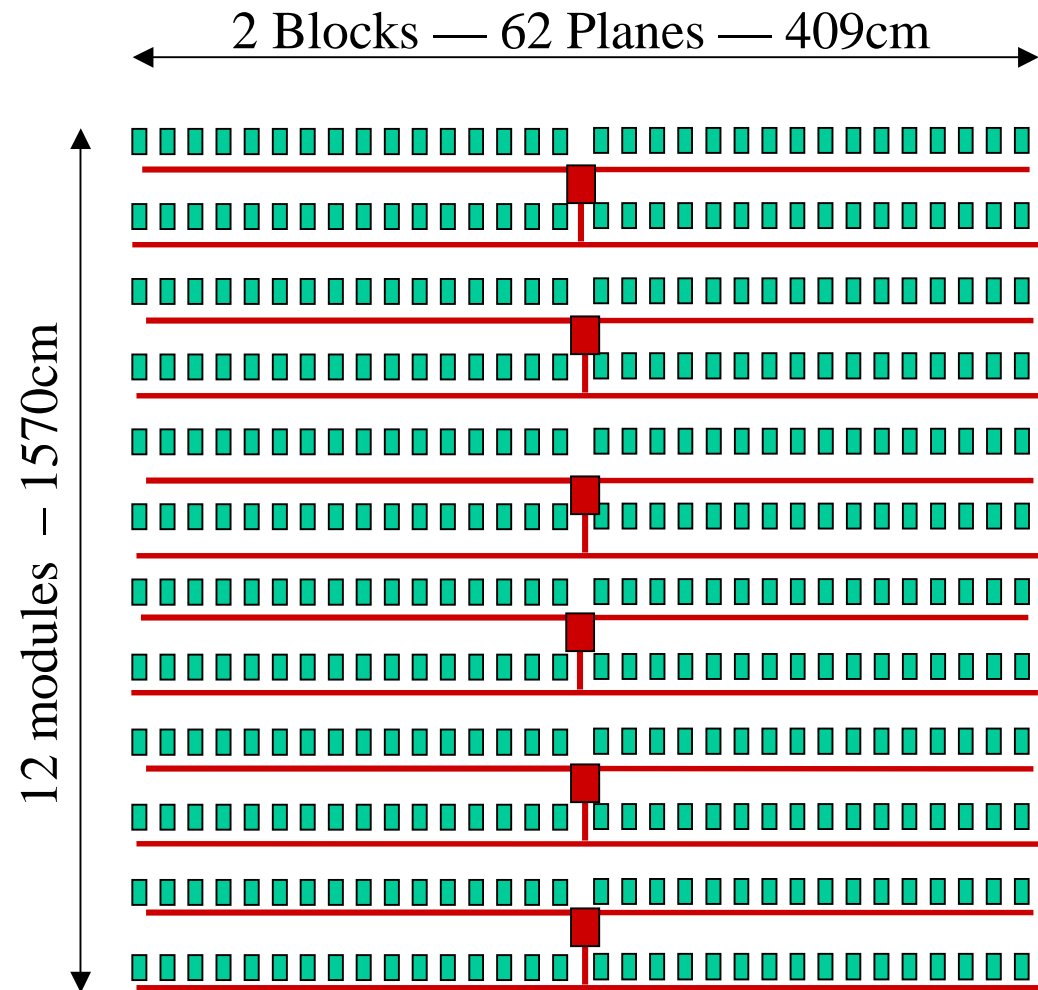
Each Power Distribution  
Box powers 64 boxes

DAQ services along same  
route from neighbor box

~2"x6" Cable Tray along  
Detector

■ Power Distribution Box

■ APD readout box





# Side Power/Data



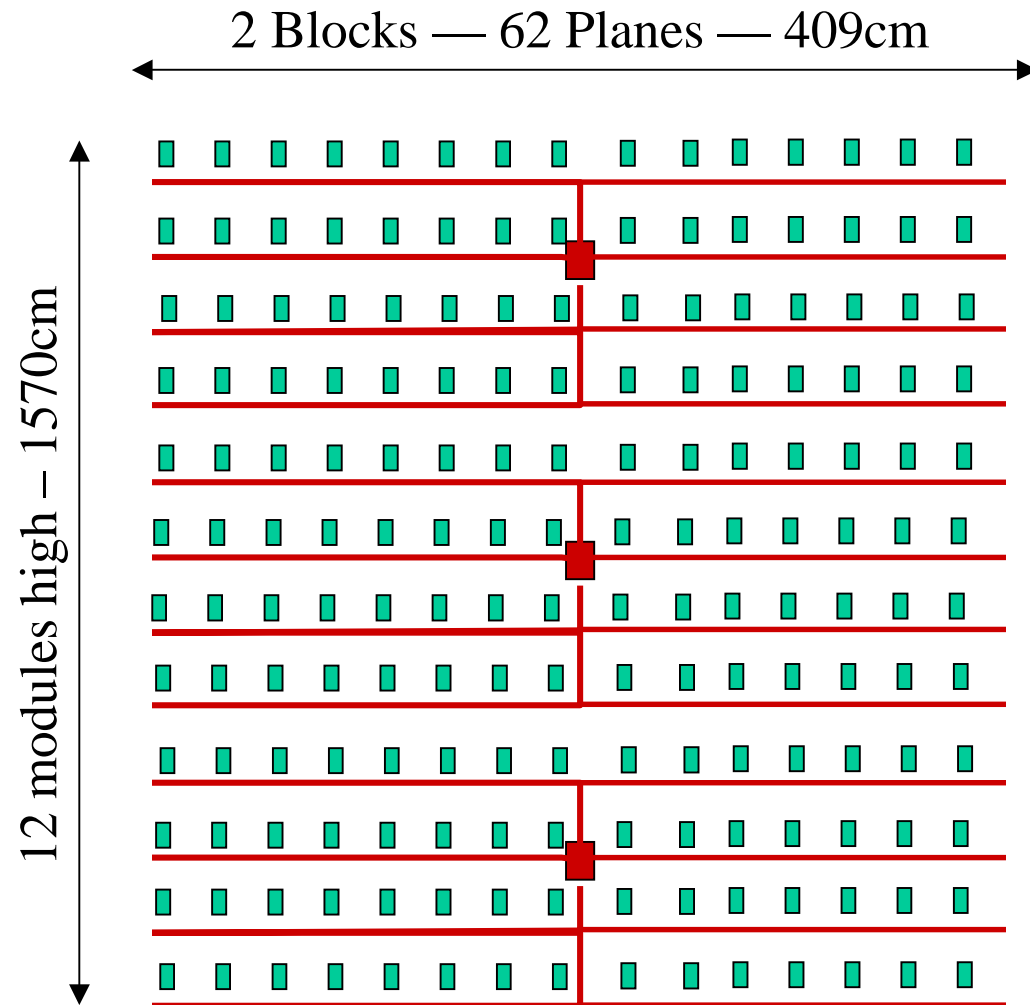
High Voltage  
Low Voltage  
Local redistribution  
(2.3m avg. cable length)

Each Power Distribution Box  
powers 60 boxes

DAQ services along same  
route

■ Power Distribution Box

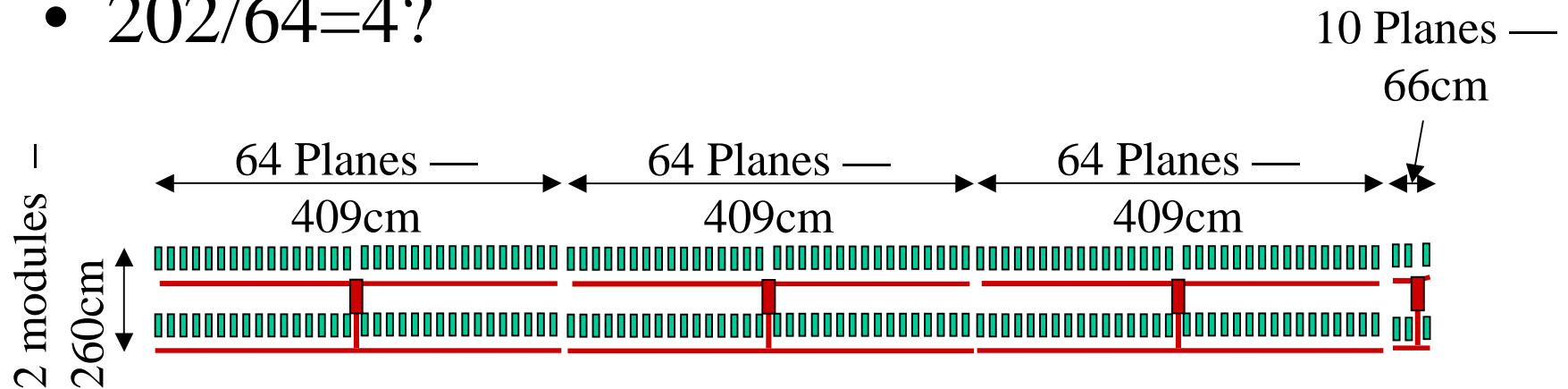
■ APD readout box





# IPND Top Power

- Distribution to 202 modules
- $202/64=4?$



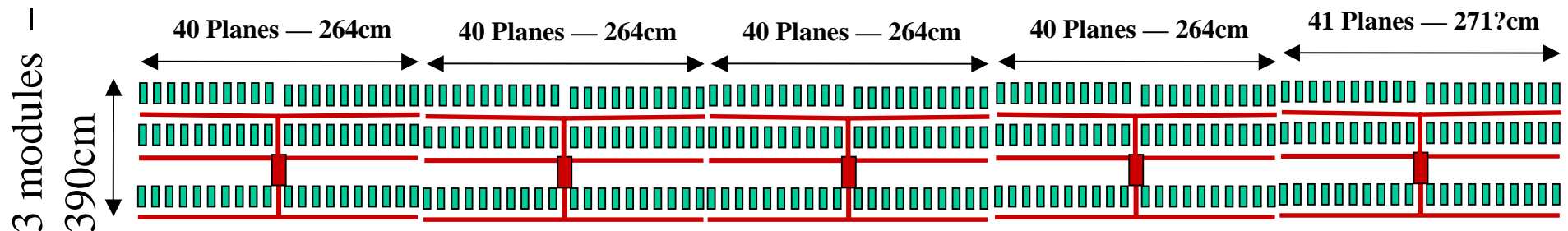
- Can we drop 10 planes?
- Better Distribution with 50/50/50/52
  - Special channel map for DAQ



# IPND Side Power



- Distribution to 303 modules
- $303/64=5?$
- $60/60/60/60/63$





# IPND data rates



- Muon Rate
  - Scale by area
  - $14 \cdot 3 / (15 \cdot 134) \cdot 500 \text{kHz} = 10 \text{kHz}$
- Hits per muon
  - ~50
- Bytes/hit == 10
- Data Rate:
  - $10 \text{kHz} \cdot 10 \cdot 50 = 5 \text{MB/s}$
- We'll need some triggering.
  - Can we get a MINOS spill timestamp?



# IPND Utilities and DAQ



- APD/FEB/TEC Power 1-32U Rack
  - Low Voltage 3 or fewer mainframes
  - High Voltage 1 mainframe, one card
  - 4 208?V plugs
- Water
  - 3kW of Water cooling power
    - Standalone chiller, chillers?
- DAQ/Trigger
  - 1 GB-Enet Switch
  - ~8 Trigger Nodes
  - ~4 Control/Archive nodes (interactive)



# Low Voltage



- Basic parameters:
  - 23808 modules.
  - Each module requires:
    - 3W @ 12V For TE coolers.
    - 3W @ 3V for readout electronics.
  - Distribution in 384 groups of <60,64
  - Trunk lines provide 64A @ 3V, 16A @ 12V



# Water Cooling

- 4W Heat extraction.
- Water cooling, with a temp rise of  $1^{\circ}\text{C}$ .
- Flow rate through cooling module
  - $\sim 1\text{mL/s}$
- Flow water horizontally to avoid large pressure drops.
- On top of the detector 256 APD modules in one loop -  $\sim 4.0$  gallons/minute total.
- 128 APD modules in one loop on the sides.
- Use reverse return to balance flow.
- Factor of five headroom in flow.
- APD Module Water Flow Calculation





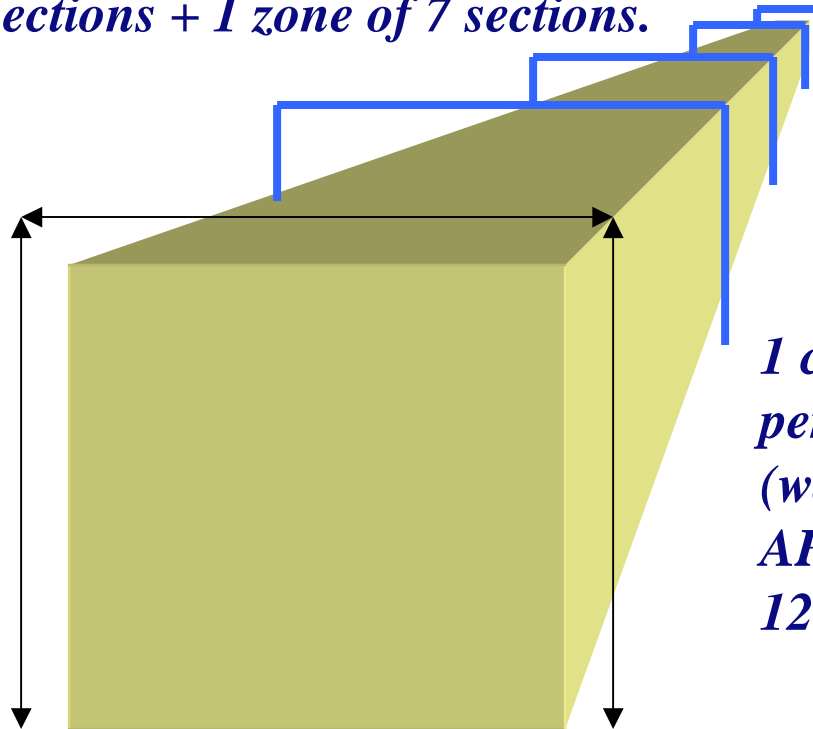
# Cooling System Zones & Dimensions



*4 cooling zones along the length of the detector  
supplied by chilled water at 48 °F supplied by FESS.*

☐ *3 zones of 8 sections + 1 zone of 7 sections.*

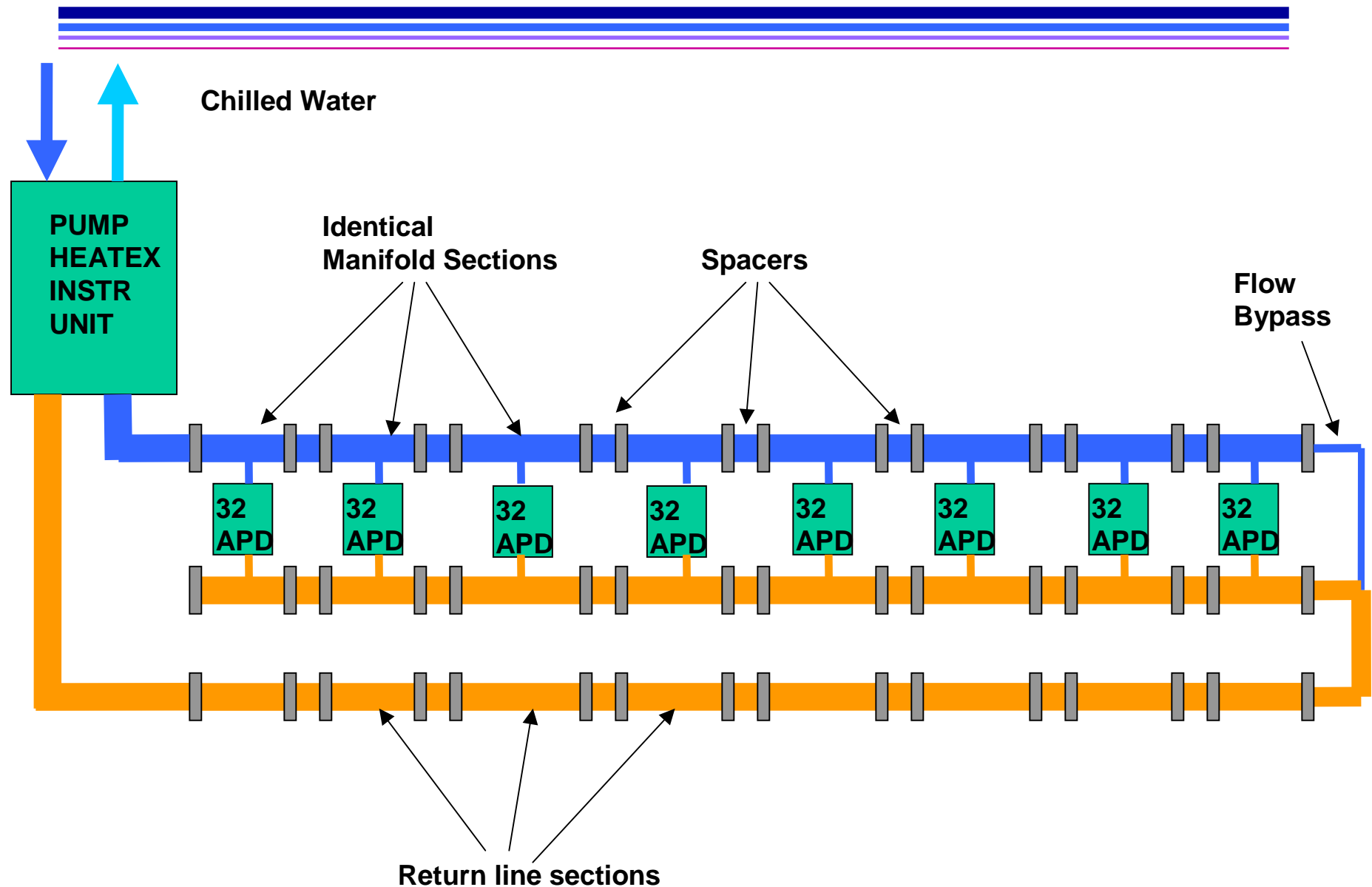
*12 rows  
of detectors  
each face*



*1 cooling loop per row,  
per zone,  
(water from heat exch to  
APDs)  
12 row x 3 face x 4 zones  
= 144 secondary loops*

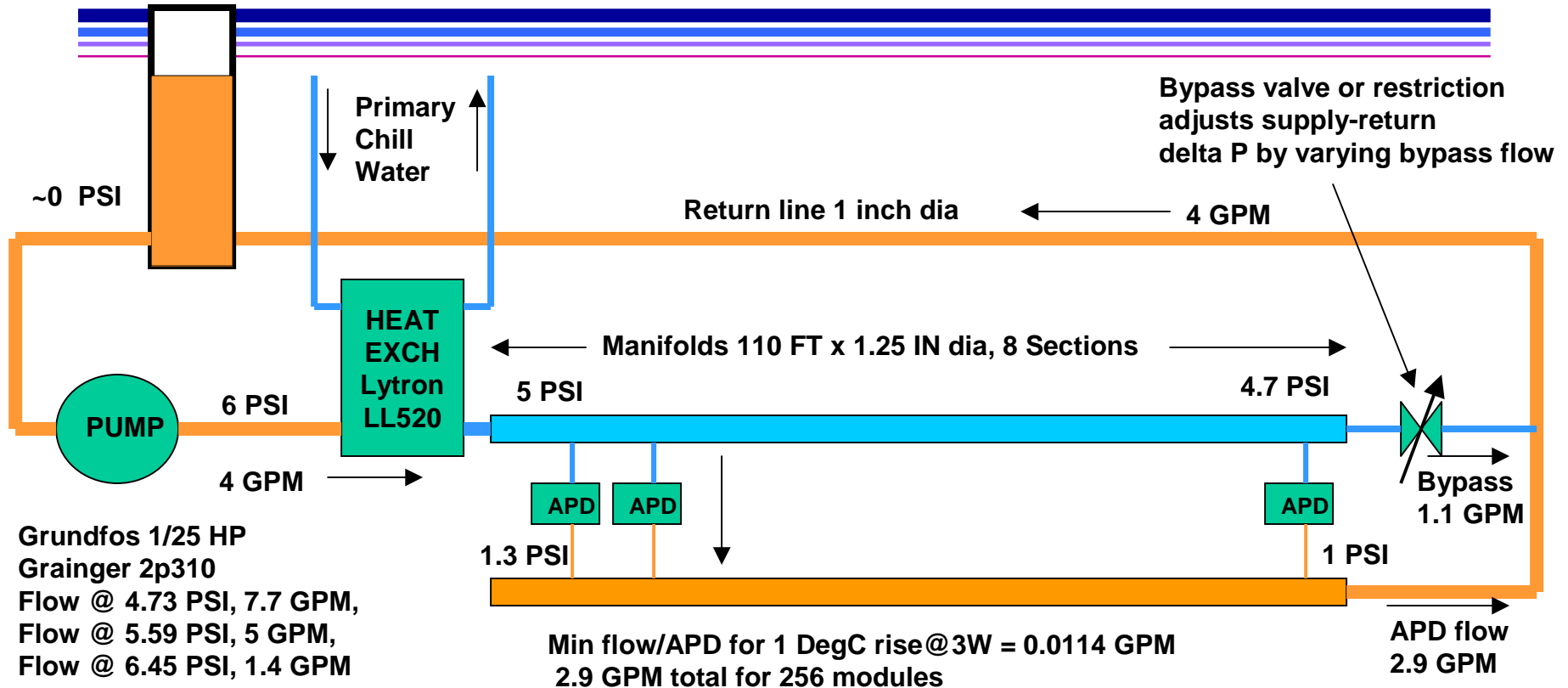


# Cooling Loop Overview





# Reverse Return Manifold w/End Bypass Example

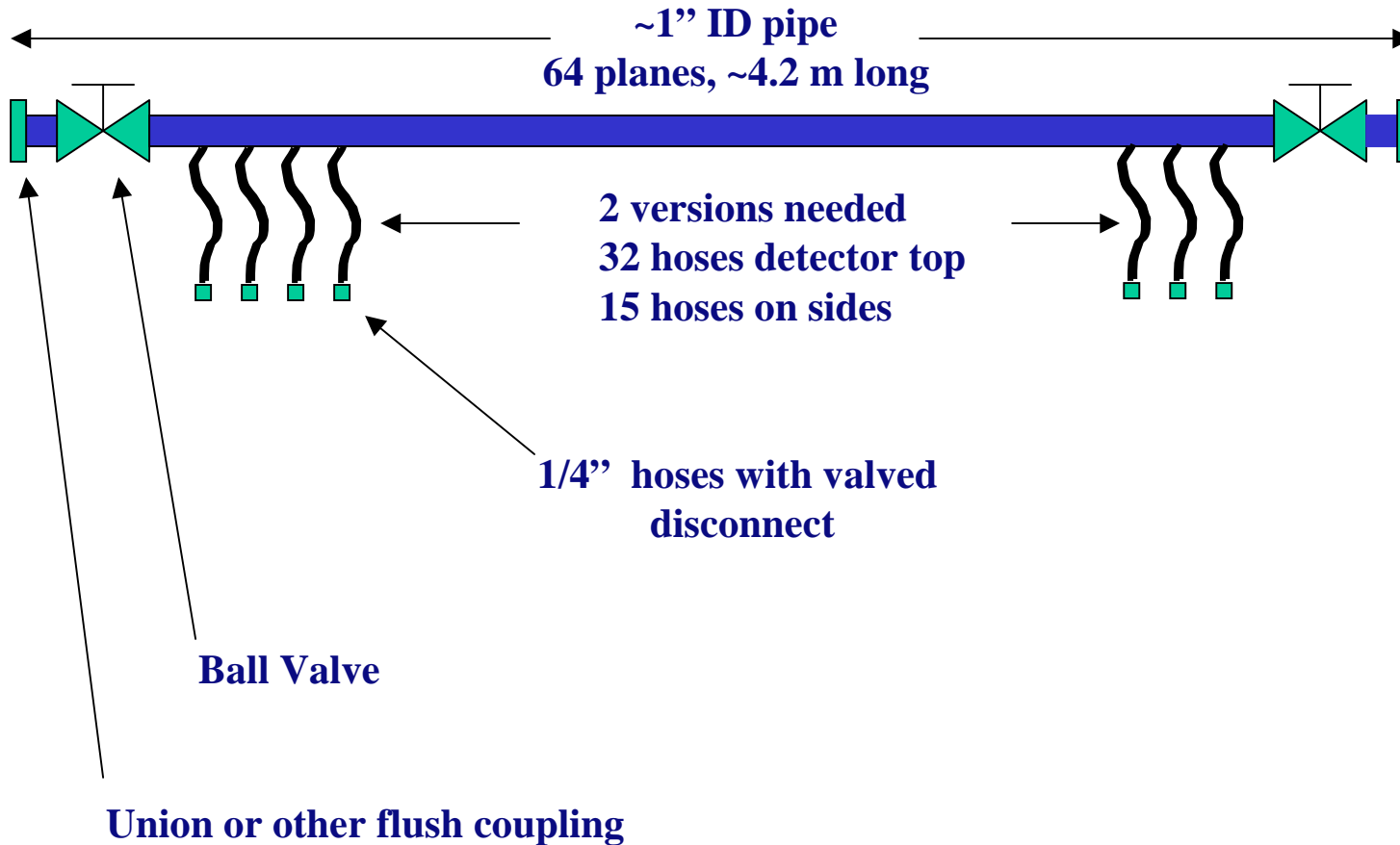


Manifold delta P same direction, but unequal due to bypass flow

**This is our strawman design.**



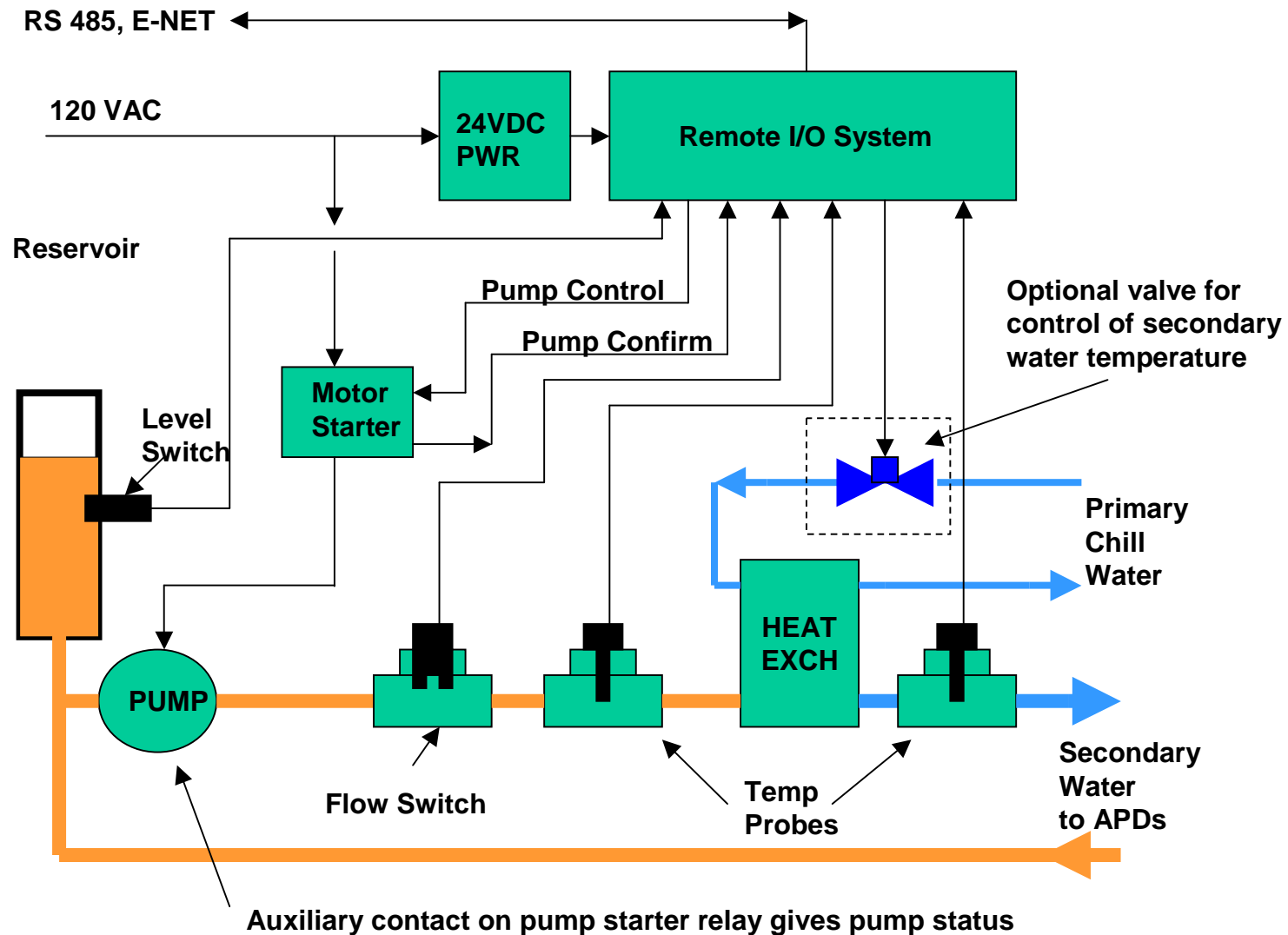
# NOVA Cooling Manifold Section



**Each manifold connects to 32(16) modules on the top (side).  
Connect eight manifolds together as the detector is built up.**

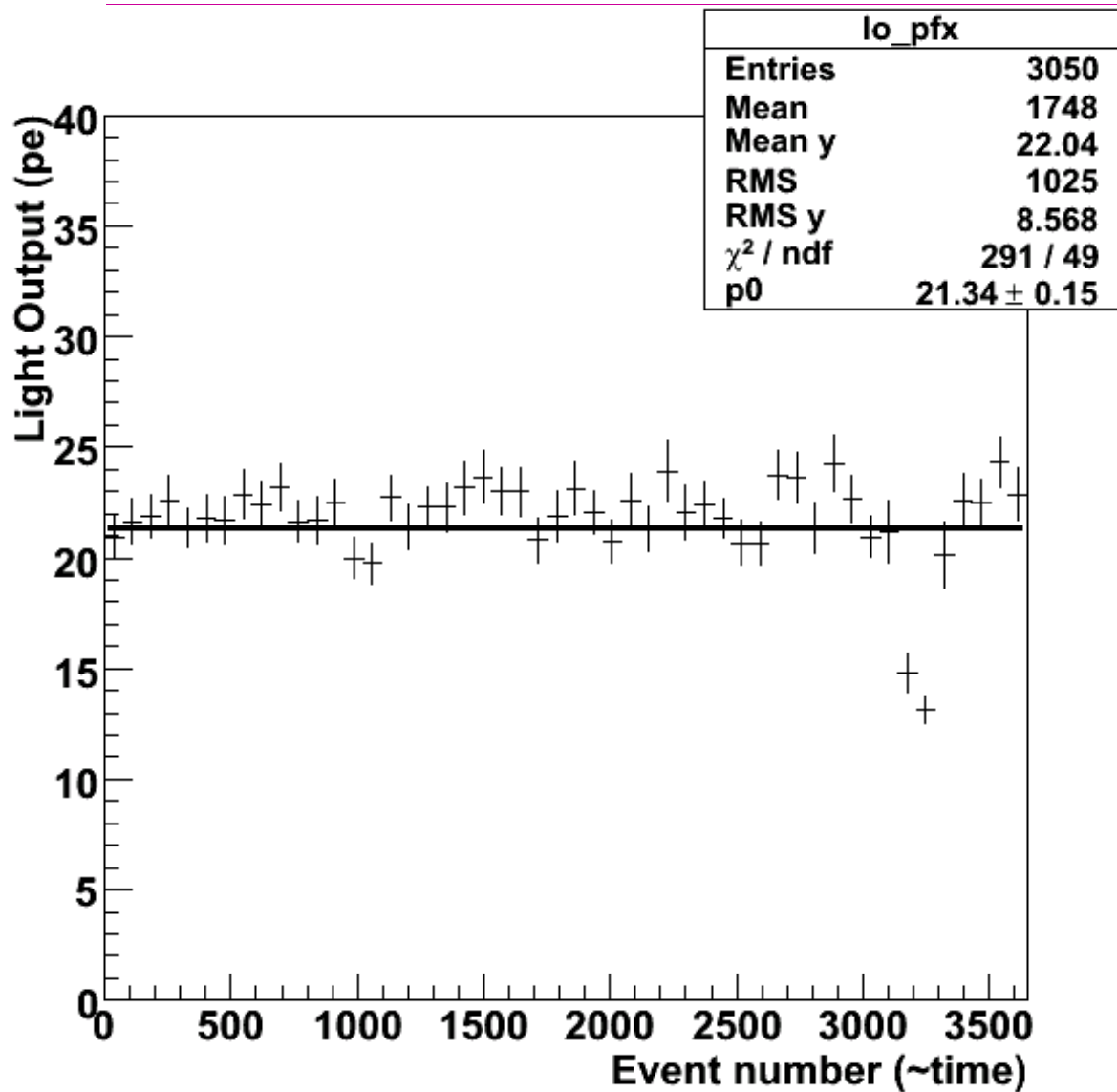


# Pump Unit & Instrumentation





# Just add water...



- What happens when you lose cooling H<sub>2</sub>O?
- Temp rises, gain goes DOWN.
- Noise goes UP
- Returns to normal after adding water